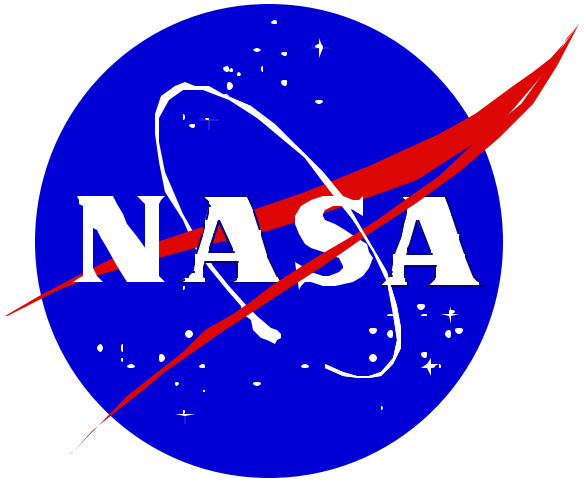
Alpha Magnetic Spectrometer – 02

Program Plan Overview

Re-baselining Outbrief

July 15, 2004

Trent Martin



LOCKHEED MARTIN

Alpha Magnetic Spectrometer – 02
Re-baselining Review Outbrief
July 15, 2004 – JSC Building 15/131

9:00-9:10	Introduction	Steve Porter/NASA -AMS Trent Martin/LMSO
9:10-9:35	Program Plan Overview	Trent Martin
9:35-10:05	AMS Flight and Manifest	Bob Miley/ISS JJ Conwell/STS
10:05-10:25	AMS Installation and Checkout Handover Plan to POIC	Paul Nemeth/LMSO Anne Vaughan/MOD
10:25-11:00	Quality System / Configuration Management	Mike Fohey/LMSO David Elmore/LMSO David Kaplan/NASA-S&MA Chris Tutt/LMSO
11:00-12:00	*Lunch*	*All*
12:00-2:00	Overview of Re-Baseline RIDs & Dispositions	Trent Martin
2:00-2:30	Risks to Project	Chris Tutt
2:30-3:00	Phase II Safety Review Plan & Issues	Leland Hill/LMSO
3:00-3:30	Road to CoFR Plan	Mike Fohey
3:30-4:00	AMS ISS ICD/PIA & SSP ICD/MIP	Bob Miley JJ Conwell

Review Team Status as of July 15, 2004 – 84 Total RIDs

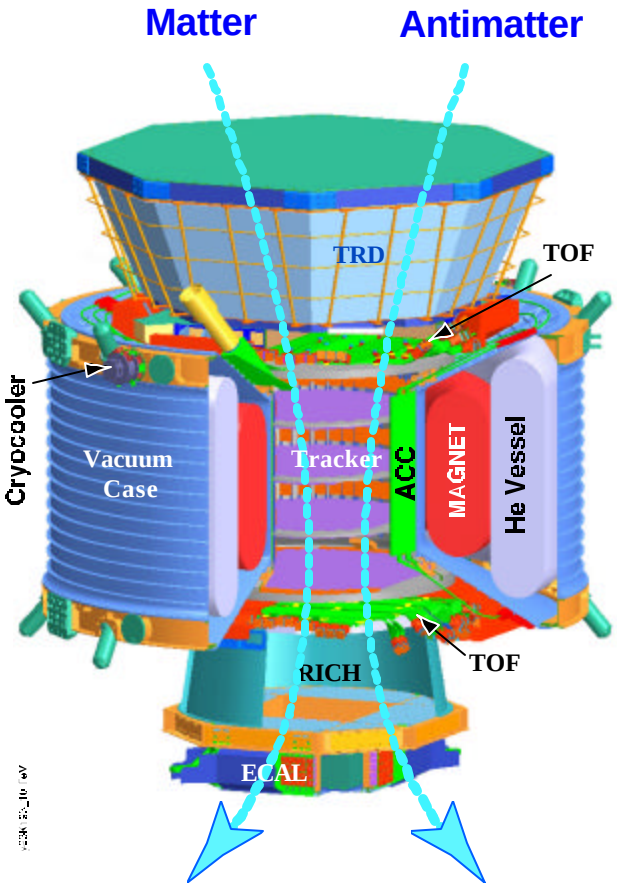
Group		Lead Reviewer	Status	RIDs	Open RIDs
EA1	AMS Project Management	Steve Porter	Complete		
		Nancy Munoz	Complete		
EA2	Web-support – Project Support	Stan Donahoe	Complete	13	6 (5-PA)
EC	MLI Production	Evelyne Orndorff	Complete		
EP	Fluid Systems	Rich Schoenberg	Complete	2	
EP	Battery Systems	Judith Jeevarajan	Complete		
ES	Structures	Dan Rybicki	Complete		
EV	SAIL Support for Avionics	Susan Morgan, Mary Harris	Complete	1	
CB	Crew Office Representative	L.D. Stevenson	Complete	6	
DO	Mission Operations	Anne Vaughan	Complete	2	1-PA
NC	Safety Engineer	Chuck Bailey	Complete		
NT	Q&MA for PIH	John Stanford, Dave Kaplan	Complete	49	
MA	Shuttle Payload Integration Manager	JJ Conwell	Complete		
OZ	ISS Payload Integration Manager	Bob Miley / Win Reid	Complete	2	2-PA
GSFC	Attached Payload Support	Ruthan Lewis	Complete		
MSFC	POIC – Payload Operations Director & Mission Ops	Ray Echols	Complete		
KSC	Launch Site Support	Jack Keifenheim	Complete	1	
AMS	Collaboration Representative	Mike Capell, Klaus Luebelsmeyer, Giuliano Laurenti	Complete	5	3 (1-PA)
LMSO	LMSO Project Team	Trent Martin, et al	Complete	3	3-PA

PA – Pending Action

Project Plan for AMS

- JSC 27296 is the Project Plan for AMS
  - Provides project framework
  - Identifies team members and responsibilities
  - Identifies WBS & Applicable Documents
  - Identifies deliverable H/W, S/W, and Documentation
- Document has been reviewed during this rebaselining effort
  - Numerous comments were received, reviewed, and dispositioned
  - The plan described today reflects all changes incorporated in the document as a result of this review

AMS: International Collaboration



478 Physicists, Engineers and Technicians in 17 Countries

Led by MIT

Sponsored by DoE

AMS Project Functional Organization Chart

Dept. Of Energy (DOE)

Div. of High Energy Physics
Dr. R. Staffin

NASA Headquarters

Exploration Systems Directorate

AMS Program Manager
Mr. M. Sistilli

National Aeronautics and Space Administration

AMS Experiment Collaboration
Prof. S. C. C. Ting (MIT)

Johnson Space Center

Engineering Directorate (EA)
AMS Project Manager
Mr. S. Porter
AMS Deputy Proj. Mngr
TBD

S&MA Office
Q&MA Liason
Mr. J. Stanford
Safety Engineer
Mr. C. Bailey

ISS / Space Shuttle Program
Payload Integration Manager
Mr. R. Miley &
Mr. W. Reid / ISS
Mr. J. J. Conwell / SSP

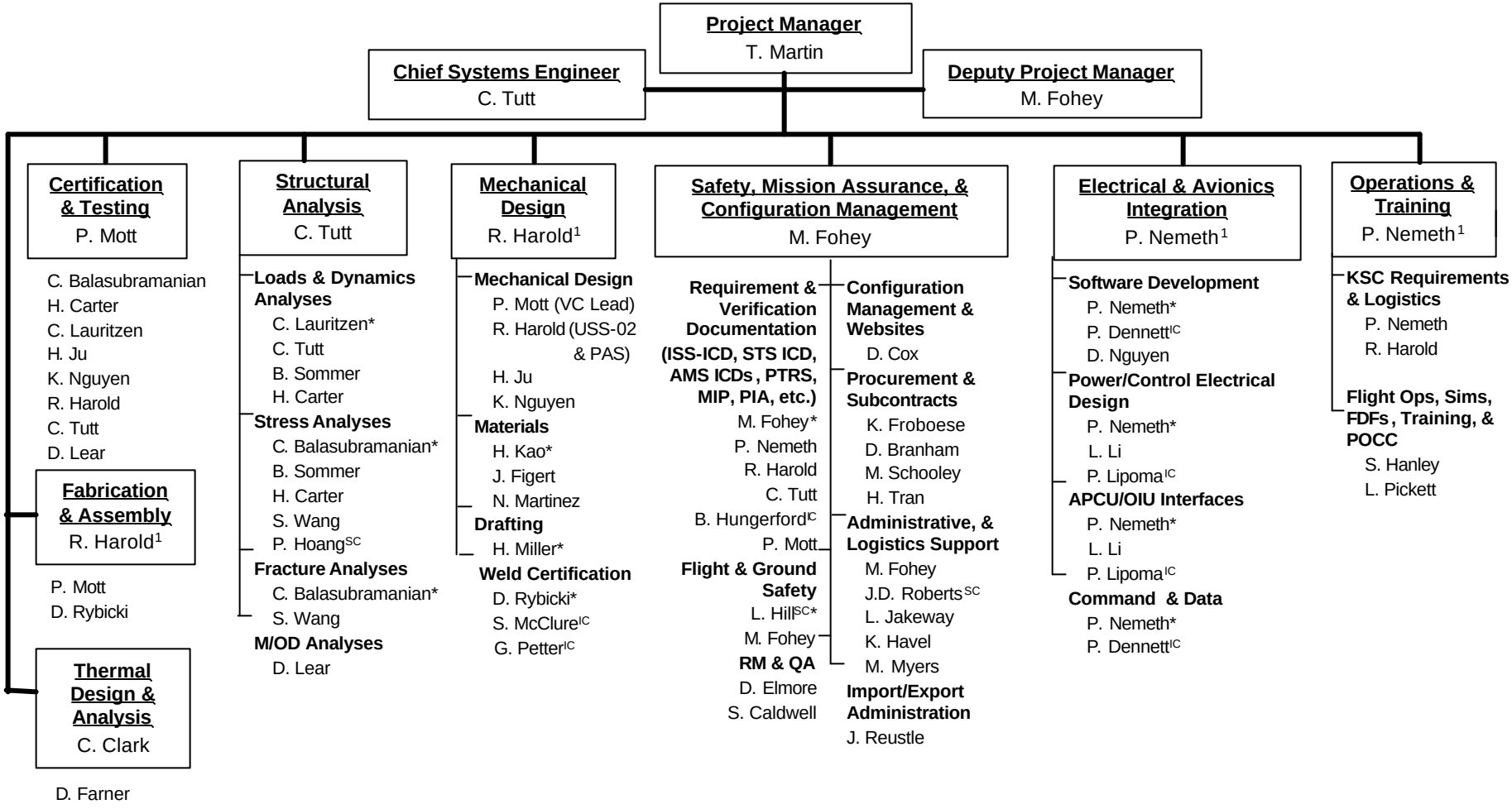
Lockheed Martin
NASA Contract
Payload Integration
Project Manager
Mr. T. Martin
Deputy Project Manager
Mr. M. Fohey

KSC
Mission Resource Manager
Mr. J. Keifenheim

GSFC
GSFC Liason
Ms. R. Lewis

Alpha Magnetic Spectrometer
NASA / DOE

Alpha Magnetic Spectrometer (AMS-02) Project
LMSO Functional Organization Chart



M/OD – Meteoroid & Orbital Debris
USS-02 – Unique Support Structure –02
IC – Independent Contractor
VC – Vacuum Case for Magnet

1 – Indicates multiple lead assignment
* – Project lead in area or function shown
SC – Sub-Contractor

AMS JSC Team Member Responsibilities

PROGRAM ACTIVITY	RESPONSIBILITY	SUPPORT	SECTION
AMS CMP (JSC27542)	EA, LMSO	AMS, EB, EC, EP, ES, EV, DA, CB, NC, NT, MO, OB, OC, OD, OZ, SA, XA, MSFC, KSC, GSFC	2.2.1
AMS Payload Interface Control Document (ICD) ICD-C (JSC29095)			
Project Plan for AMS (JSC27296)			
PTRS (JSC29789)			
Government Certification Approval Request (GCAR) & CoFR			
Verification & Validation			
Safety Data Packages			
AMS Integration Electrical & Software Development	EA, LMSO	AMS, NA, EV, EP	2.2.2
AMS Integration GSE and STE Development	EA, LMSO	AMS, NA, ES, KSC	
AMS Integration Hardware Development	EA, LMSO	AMS, NA, ES, EC, EP, EV	
AMS Experiment Flight & Ground Hardware	AMS	EA, LMSO, KSC	2.2.3
ACOP Development	AMS	OZ	
AMS Payload Drawings, Stress, Fracture, Thermal and Materials Analysis	AMS, EA, LMSO	NA, ES, EC, EV, EP	2.2.4

AMS JSC Team Member Responsibilities

IDRDs & Annexes	OC	EA, LMSO, AMS, OZ	2.2.5
Payload Integration Agreement (PIA)	OZ	EA, LMSO, AMS, OB, OC, OD, KSC, MSFC, DA, XA, CB, MO	2.2.6
ISS/AMS Hardware ICD (SSP-57213)		EA, LMSO, NA	
ISS/AMS Software ICD (SSP-57313)		EA, LMSO, NA	
HOSC	MSFC	EA, LMSO, AMS, OZ	2.2.7
PDL	MSFC/LMSO	EA, AMS, OZ	2.2.8
Mission Planning, Training & MCC	DA, OZ	EA, LMSO, AMS	2.2.9
Mission Integration Plan (MIP) (Including Annexes)	MO	EA, LMSO, OC, OZ	2.2.10
NSTS/AMS ICD-A-TBD		EA, LMSO, OZ, NA	

Additional detail on support responsibilities can be found in Section 2.2.

JSC Facility Usage

- J13 SML (Structures and Mechanics Laboratory) (for component Static Testing)
- J14 EMI (Electromagnetic Interference) Chamber
- J16 SAIL (Shuttle Avionics Integration Laboratory) & OIU Laboratory
- J32/J33 Thermal Vacuum Chambers (Thermal Vacuum & Thermal Cycle)
- J44 ESTL (Electronic Systems Test Laboratory)
- J49 VATF (Vibration Test Facility)
- J8 Photolab Facility
- J9/J10 Manufacturing and Materials Processing
- J9 SVMF (Space Vehicle Mockup Facility)
- NBL (Neutral Buoyancy Laboratory)
- HITF (Hypervelocity Impact Technology Facility)
- J16 – High Bay Controlled Storage Facility
- J50 – High Bay Controlled Storage Facility

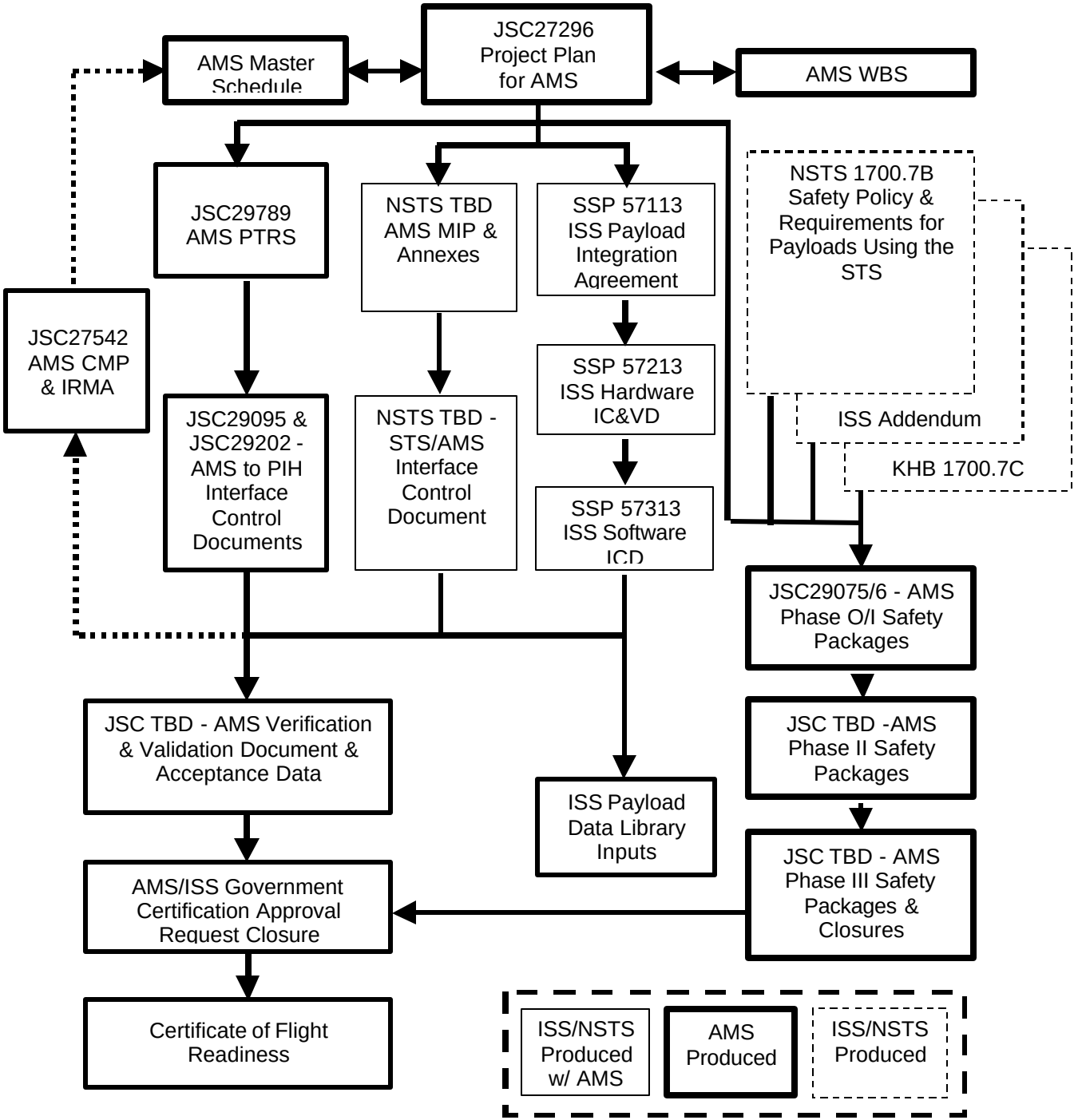
Major Completed Reviews

- Preliminary Design Review (PDR) (June 21-23, 2000)
- Phase I Flight Safety Review (January 16-18, 2001)
- Phase I Ground Safety Review (March 26-27, 2002)
- Special PSRP Review of Payload Bay Venting (January 17, 2003)
- Critical Design Review (CDR) (May 13-18, 2003)
- Langley Independent Assessment Team Review (June 18-19, 2003)
- Payload Attach System (PAS) Hardware Review (August 7, 2003)
- JSC Independent Cost Estimate Review (January-February, 2004)

Major Upcoming Reviews

- Phase II Flight Safety Review
- Phase II Ground Safety Review
- Phase III Flight Safety Review
- Phase III Ground Safety Review
- Systems Acceptance Review
- Flight Readiness Review

AMS Documentation Tree



Project Documentation

Document #	Document Name	Delivery Date	Responsibility	Control Authority
N/A	AMS Master Schedule	Update As Required	LM/EA/AMS	AMS CCB
JSC 27296 Appendix A	AMS WBS	Update As Required	LM/EA	AMS CCB
JSC 27296	Project Plan	PDR – CDR - Rebaselining	LM/EA	AMS CCB
JSC 27542	Configuration Management Plan	PDR – CDR - Rebaselining	LM/EA	AMS CCB
JSC 29789	Project Technical Requirements Specification	PDR – CDR - Rebaselining	LM/EA	AMS CCB
JSC TBD	Verification and Validation Document	L-36	LM/EA	AMS CCB
JSC 29095	AMS to PIH ICD	PDR – CDR - Rebaselining	LM/EA	AMS CCB
JSC 29202	AMS to VC ICD	PDR – CDR - Rebaselining	LM/EA	AMS CCB
SSP 57113	AMS Payload Integration Agreement	CDR - Rebaselining	OZ	ISS PCB
SSP 57213	AMS to ISS H/W ICD	CDR - Rebaselining	OZ	ISS PCB
SSP 57313	AMS to ISS S/W ICD	L-12 – Preliminary L-3 - Final	OZ	ISS PCB
NSTS TBD	AMS to STS MIP	L-36	MO	SSP/ISS JIPT

Project Documentation, Cont.

NSTS TBD	AMS to STS ICD	L-30	MO	SSP/ISS JIPT
JSC 29075	Phase O/I Flight Safety Review Data Package	FSR Phase O/I	LM/EA	AMS CCB
JSC TBD	Phase II Flight Safety Review Data Package	FSR Phase II	LM/EA	AMS CCB
JSC TBD	Phase III Flight Safety Review Data Package	FSR Phase III	LM/EA	AMS CCB
JSC 29076	Phase O/I Ground Safety Review Data Package	GSR Phase O/I	LM/EA	AMS CCB
JSC TBD	Phase II Ground Safety Review Data Package	GSR Phase II	LM/EA	AMS CCB
JSC TBD	Phase III Ground Safety Review Data Package	GSR Phase III	LM/EA	AMS CCB
JSC TBD	AMS Verification Data and Acceptance Data Package	L-6	LM/EA	AMS CCB
JSC TBD	GCAR	L-4	LM/EA/NA	AMS CCB

NASA/AMS Provided Flight Hardware

ITEM	UNITS
Cryomagnet Vacuum Case (VC) (Flight Article)	1
Safety Critical Meteoroid and Orbital Debris (M/OD) shields	at least 2
Payload Attach System (PAS) (Passive Half)	1
EVA Interface Panel (Interface to UMA)	1
Interface Panel A (Interface to ROEU/PDA)	1
Cabling from interface panels to J-Crate and PDB	1
Digital Data Recording System (DDRS–02) and associated cabling/interface cards/software	1
Thermal Blankets	6
Unique Support Structure-02 (USS-02)	1
Brackets to interface the EBCS, FRGF, PVGF, ROEU/PDA, and UMA to the USS-02	1 Each

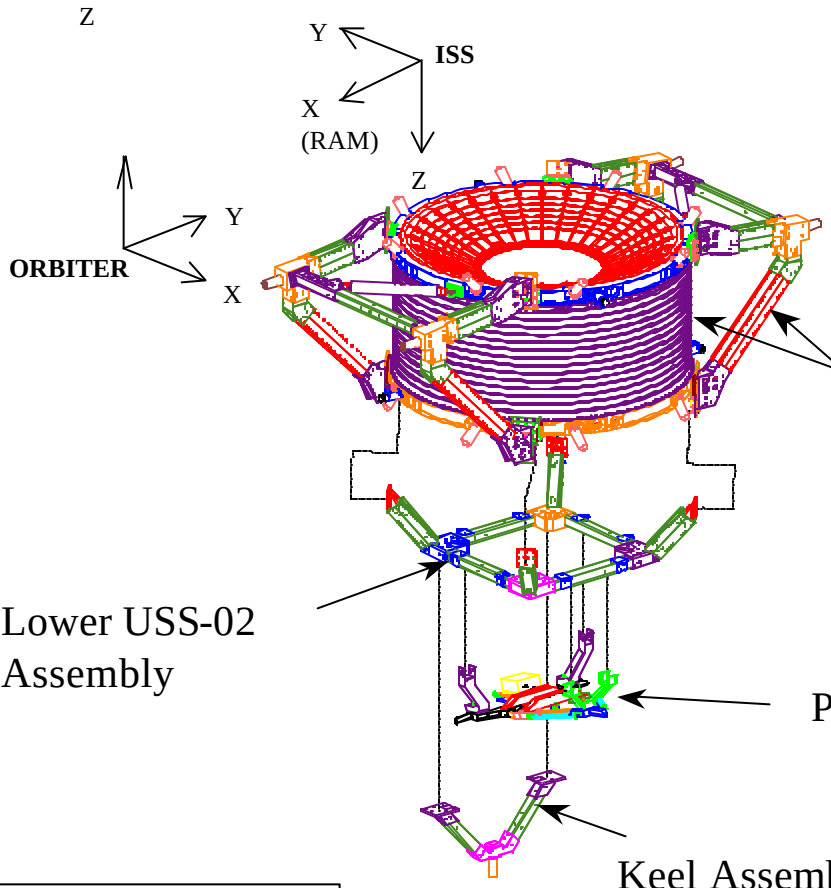
NASA ISS/STS Provided Flight Hardware

ITEM	UNITS
Electronic Berthing Camera System (EBCS) w/cables	1
EVA (Extravehicular Activity) Handrails	10 or less
Flight Releasable Grapple Fixture (FRGF)	1
Portable Foot Restraints (PFR) Worksite Interface Fixture (WIF)	1
Power Video Grapple Fixture (PVGF) w/cables	1
Remotely Operated Electrical Umbilical/Payload Disconnect Assembly (ROEU/PDA) w/cables	1
Umbilical Mechanism Assembly (UMA) (Passive Half) w/cables	1

NASA/AMS Provided GSE/STE

ITEM	UNITS
VC Structural Test Article (STA) (NOTE: VC STA also serves as Flight Spare VC)	1
Primary Support Stand (PSS)	1
Lower USS Support Fixture	1
Primary Lifting Fixture	1
Multi-purpose Lifting Fixture	2
Intermediate Support Fixtures	4
USS-02 Assembly Fixture	1
Vacuum Case Test Fixture (VCTF)	1
Special Test Equipment (STE) for Structural Testing	Multiple
Neutral Buoyancy Laboratory (NBL) Mockup	1
VC/Magnet Shipping Fixture	2

NASA – Payload Integration Hardware



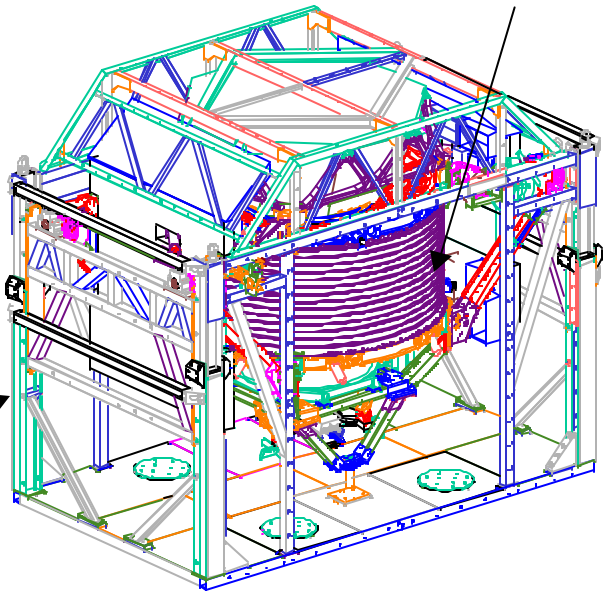
Upper USS-02 Assembly (Includes Vacuum Case)

Lower USS-02 Assembly

PAS Assembly

Keel Assembly

AMS-02 Payload Assembly



Primary Support Stand

All fasteners #8 or larger for entire payload are provided by JSC, and go through JSC Fastener Integrity Program

Current Status of AMS-02 PIH Development and Fabrication

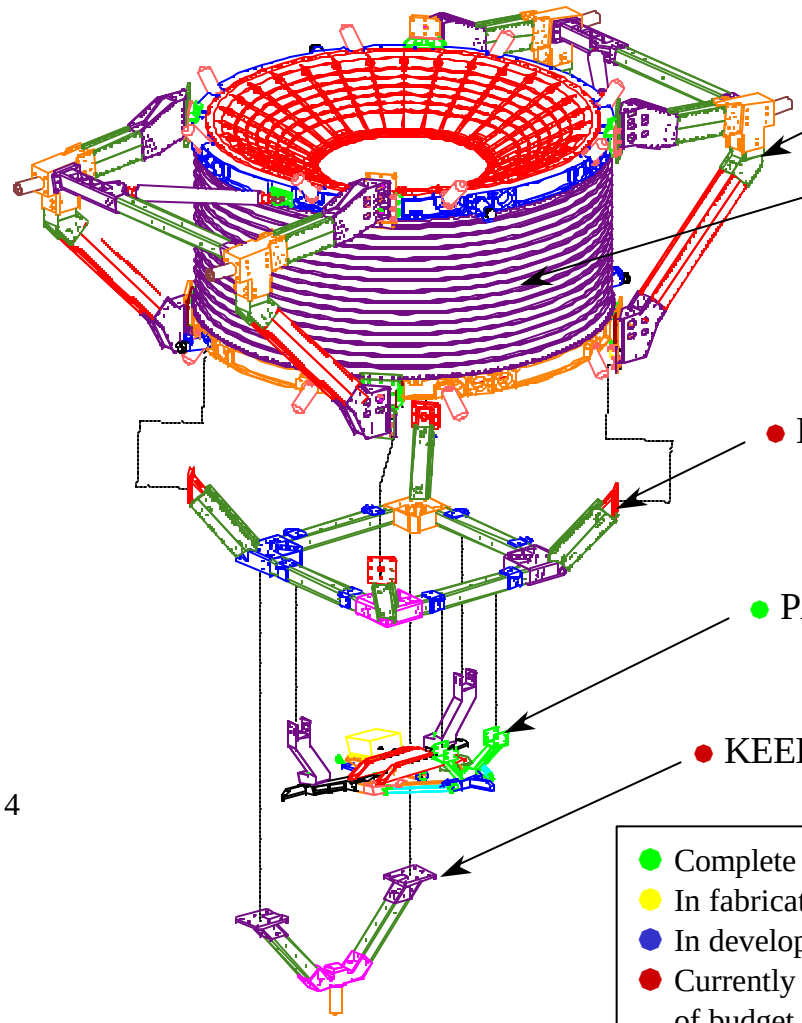
Other NASA Payload Integration Hardware includes:

Flight

- Umbilical Mechanism Assembly
- External Berthing Camera System
- Power Video Grapple Fixture
- Flight Releasable Grapple Fixture
- Handrails & Worksite Interface
- Remotely Operated Electrical Umbilical
- EVA Connector Panel
- Digital Data Recording System-02
- Micrometeoroid & Orbital Debris Shielding
- Interface Brackets

Non-Flight

- Multi-Purpose Lift Fixture x 2
- Primary Lift Fixture
- Primary Support Stand
- Vacuum Case Test Fixture
- O-ring Test Fixture
- NBL Mockup
- Intermediate Support Fixture x 4
- Assembly Fixture
- PAS Test Fixture
- Misc. Test Fixtures
- Static and Modal Test Fixtures
- Acoustic Test Fixture



- Complete
- In fabrication at Subcontractor
- In development & on schedule
- Currently stalled pending resolution of budget issues – AF manufacturing work has begun with savings from '04

Work Breakdown Structure

- The WBS has been developed to include all tasks to be performed by NASA
- Cost plan has been developed based on WBS
- Cost reporting will be compared to plan and appropriate variance and Earned Value measurements have been implemented
- Complete WBS has been added to Project Plan

AMS WBS

WBS Code	AMS WBS Title	NASA Products
1.0	Management & Control	Overall project management reports & schedules
2.0	Systems Engineering & Integration	Systems engineering & integration documentation and drawings
2.1	Requirements Definition	Payload documentation & Integration
2.2	Design	Overall design drawings
2.3	Flight Production & Certification	Integrated Hardware Production & Cert.
2.4	Deployment	Integrated Hardware Assembly
2.5	Operations	All integrated operations
3.0	AMS Experiment Mentoring & Integration	Experiment component integrated into PIH
3.1	Cryomagnet Subsystem	Integrated & safety certified cryomagnet system
3.1.1	SFHe Tank	Integrated & safety certified SFHe tank system
3.1.2	Magnet System	Integrated & safety certified magnet
3.1.3	Cryogenic System	Integrated & safety certified cryogenic system
3.1.4	Non-linear Support Strap System	Integrated & safety certified strap system
3.1.5	STA Cryomagnet Acoustic Test	Acoustic test plan and report
3.1.6	STA Cryomagnet Sine Sweep Test	Sine Sweep test plan and report
3.2	Transition Radiation Detector	Integrated & safety certified TRD
3.3	Time of Flight Detectors	Integrated & safety certified TOFs
3.4	Tracker	Integrated & safety certified Tracker
3.5	Anti-Coincidence Counter	Integrated & safety certified ACC
3.6	Ring Imaging Cherenkov Counter	Integrated & safety certified RICH
3.7	Electromagnetic Calorimeter	Integrated & safety certified ECAL
3.8	Electronics	Integrated & safety certified Electronics
3.9	Thermal Control System	Integrated & safety certified TCS
3.10	AMS Crew Operations Post	None

AMS WBS

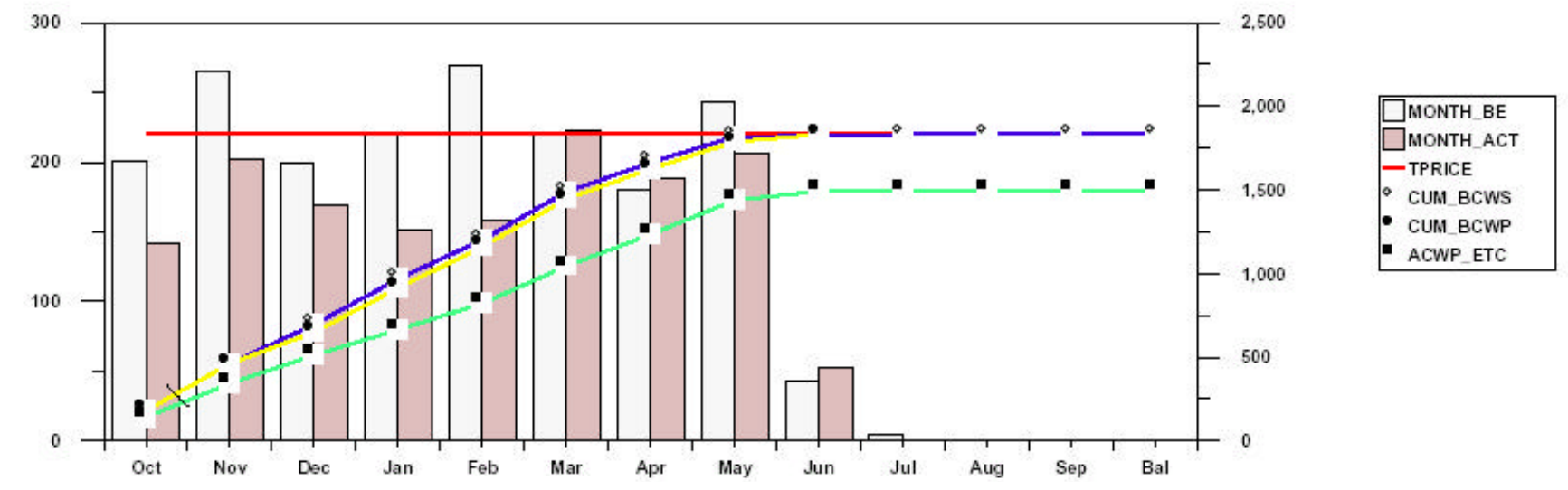
WBS Code	AMS WBS Title	NASA Products
4.0	Payload Integration Hardware Development, Integration & Certification	All PIH Hardware and Software
4.1	Flight Hardware	All PIH Flight Hardware and Software
4.1.1	USS-02	USS-02
4.1.2	Flight & STA VC	VCs
4.1.3	STS & ISS Integration Hardware	STS & ISS Integration H/W and S/W
4.1.4	Micro Meteoroid & Orbital Debris Shields	MMOD shields for safety critical hardware
4.2	Ground Support Equipment & Special Test Equipment	All GSE/STE
4.2.1	Primary Support Stand	PSS
4.2.2	Vacuum Case Test Fixture	VCTF
4.2.3	O-ring Test Fixture	OTF
4.2.4	Multi-purpose Lift Fixtures	MPLF x 2
4.2.5	Primary Lift Fixture	PLF
4.2.6	Intermediate Support Fixtures	ISF x 4
4.2.7	Assembly Fixture	AF
4.2.8	Lower USS Shipping Fixture	LUSS Shipping Fixture
4.2.9	VC Shipping Fixture	VC Shipping Fixture x 2
4.2.10	PAS Test Fixture	PAS Test Fixture
4.2.11	Static Test Fixtures	Static Test Fixtures for full up static test
4.2.12	Modal Test Fixtures	Modal Test Fixtures for full up modal test
4.2.13	Acoustic Test Fixtures	Acoustic Test Fixtures
4.2.14	Misc. Test Fixtures	Misc. Test Fixtures
4.2.15	NBL Mockups	NBL Mockups

Note: More detailed WBS available in Project Plan

LM Cost Reporting

- The majority of the AMS project costs are directly from the LM contract
- AMS is currently small task on the Science, Engineering, Analysis, and Test (SEAT) Contract
- Current LM contract (SEAT) with NASA ends on December 31, 2004 (likely to extend to at least January 31, 2005)
- Follow on contract (ESC) is currently being competed

LM Monthly Variance Assessment



MHECSMBSX M Alpha Magnetic Spectrometer (AMS) Payload

Accounting Month: Jun 2004 Status Through: 06/29/2004

Division Code: SM

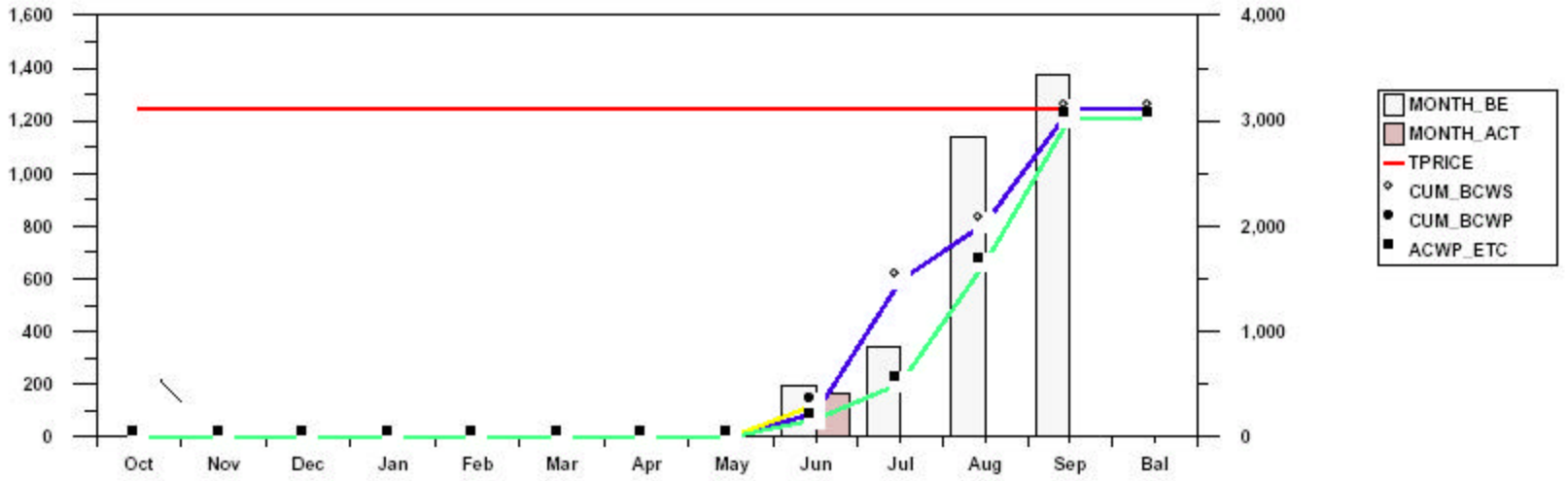
Overall	Sched	Tech	Cost	Suppl
GREEN	GREEN	GREEN	GREEN	GREEN

% Complete	99.9%			
Cum BCWS	$1,823.4	SV	$8.8	0.5%
Cum BCWP	$1,832.1			
Cum ACWP	$1,491.8	CV	$340.4	18.6%
BAC	$1,833.1			
EAC	$1,496.8	VAC	$336.3	18.3%

NASA:	LM:
PORTER, S	MARTIN, TD

MHECRABSX ORIG Alpha Magnetic Spectrometer (AMS) Payload

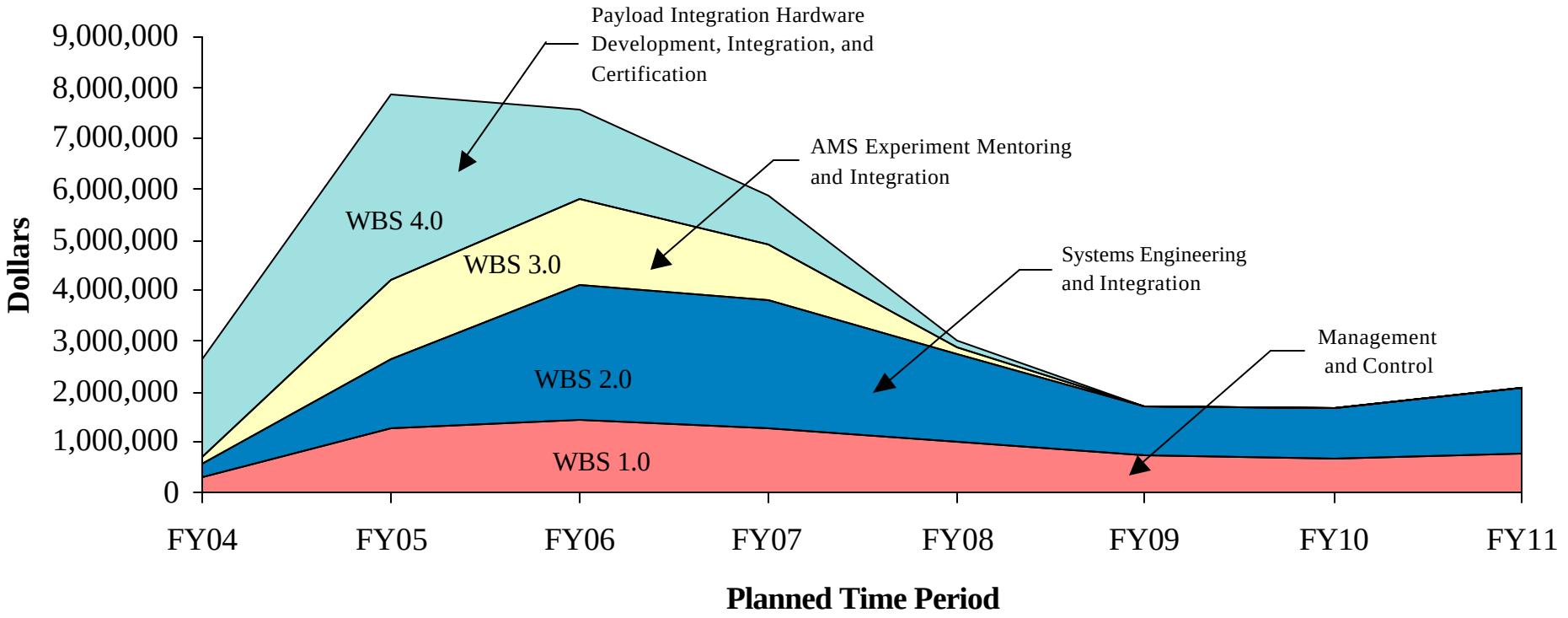
Accounting Month: Jun 2004



Total Project Cost Reporting

- In addition to LM reporting, we have now implemented a monthly variance assessment of the entire AMS Project
  - Includes all NASA costs
    - Direct Civil Servant (CS) costs
    - ITAs with other Directorates
    - CS Travel Costs
  - Includes all contractor costs (mostly LM)
  - Record costs to 25 different cost accounts
    - Earned Value metrics will be gathered for each cost account
    - Lower level WBS elements will be rolled up to top level WBS
    - Top level WBS elements will be rolled to Project Level
    - Variance graphs and data will be provided for each level

NASA AMS Cost Plan



Note: Data is from June 2004 forward – Makes FY04 numbers look slightly skewed.